Thrust Area 2:
Sensors Testbed (Plasmonic and Electrochemical)

Thrust Area Leader: Alice White

Nanosystems Engineering Research Center for Directed Multiscale Assembly of Cellular Metamaterials with Nanoscale Precision

National Science Foundation: EEC-1647837

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CELL-MET

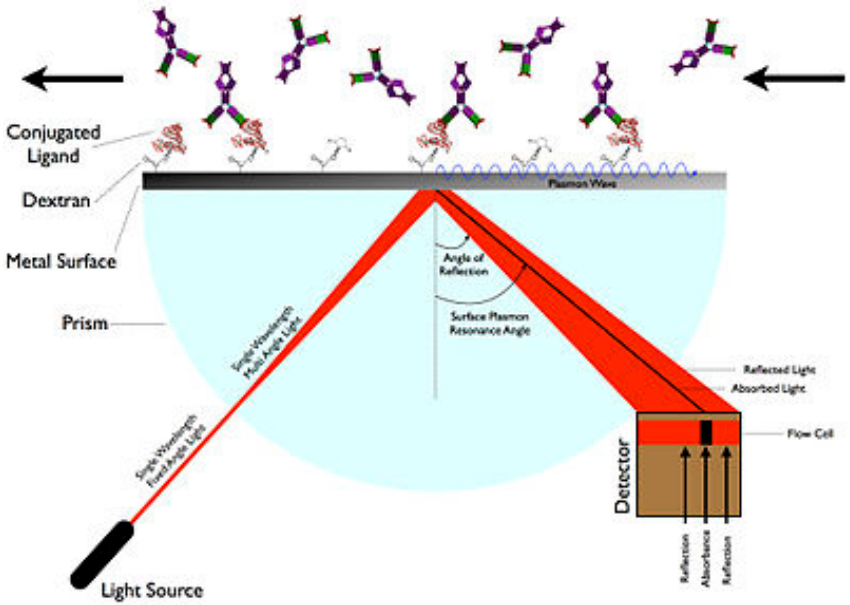
Overview

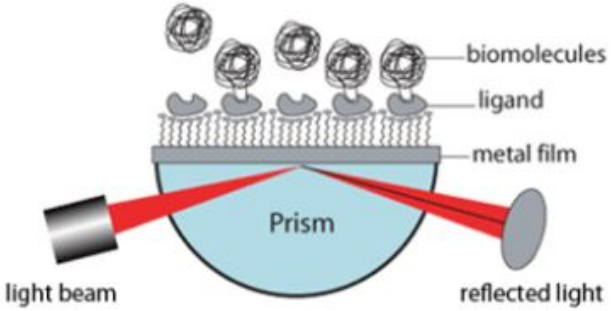
- Sensors in our lab
- Introduction to Surface Plasmon Resonance (SPR)
- Our device introduction and capabilities
- Cell-Integrated SPR challenges
- Applications in CELL-MET

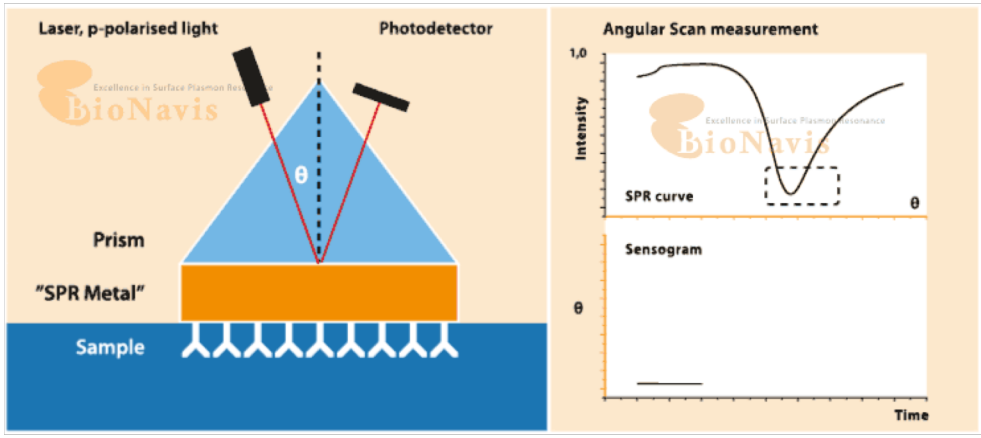
Sensors in Li's lab

- Optical
  - Fluorescent based sensors (ATP, O2, Lactate, Glucose)
  - Plasmonic based sensors (Surface plasmon reocnance)
- Electrochemical
  - Lateral flow EC strips
  - Vertical flow strips
  - Glucose / lactate sensors
- MEMS-based devices
- Microelectrodes

How does SPR work?







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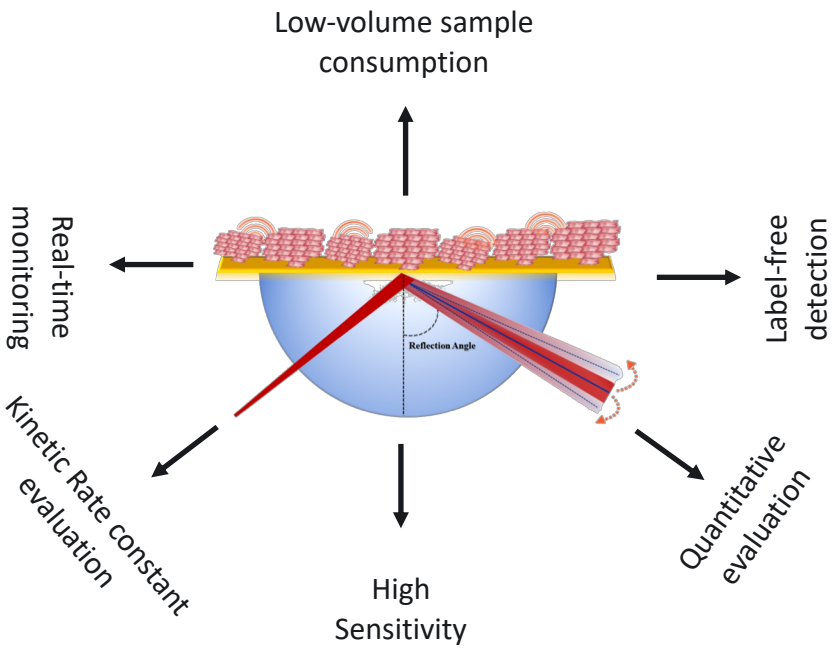
Why use SPR?

Applications of SPR:

1. Antibody-antigen binding kinetics
2. Molecular interactions' kinetics (association, dissociation)
3. Control over orientation of proteins on the surface
4. Electrical stimulation and electrochemical sensing
5. Vesicle-release analysis from cells
6. Cell attachment monitoring in real time
7. Cellular micromotion analysis in real-time



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BI2000 Capabilities

- An injection port, two injection channels with capability of parallel or serial injections through both channels
- A static module (bottom left) for electrochemical SPR sensing with a reservoir for fluid
- A dynamic flow-through module (bottom right) for having a dynamic alternative flow over the sensor chip
- Newer models have microscopy also embedded within the system for real-time bright field imaging of cells

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Three-Plane Diagram

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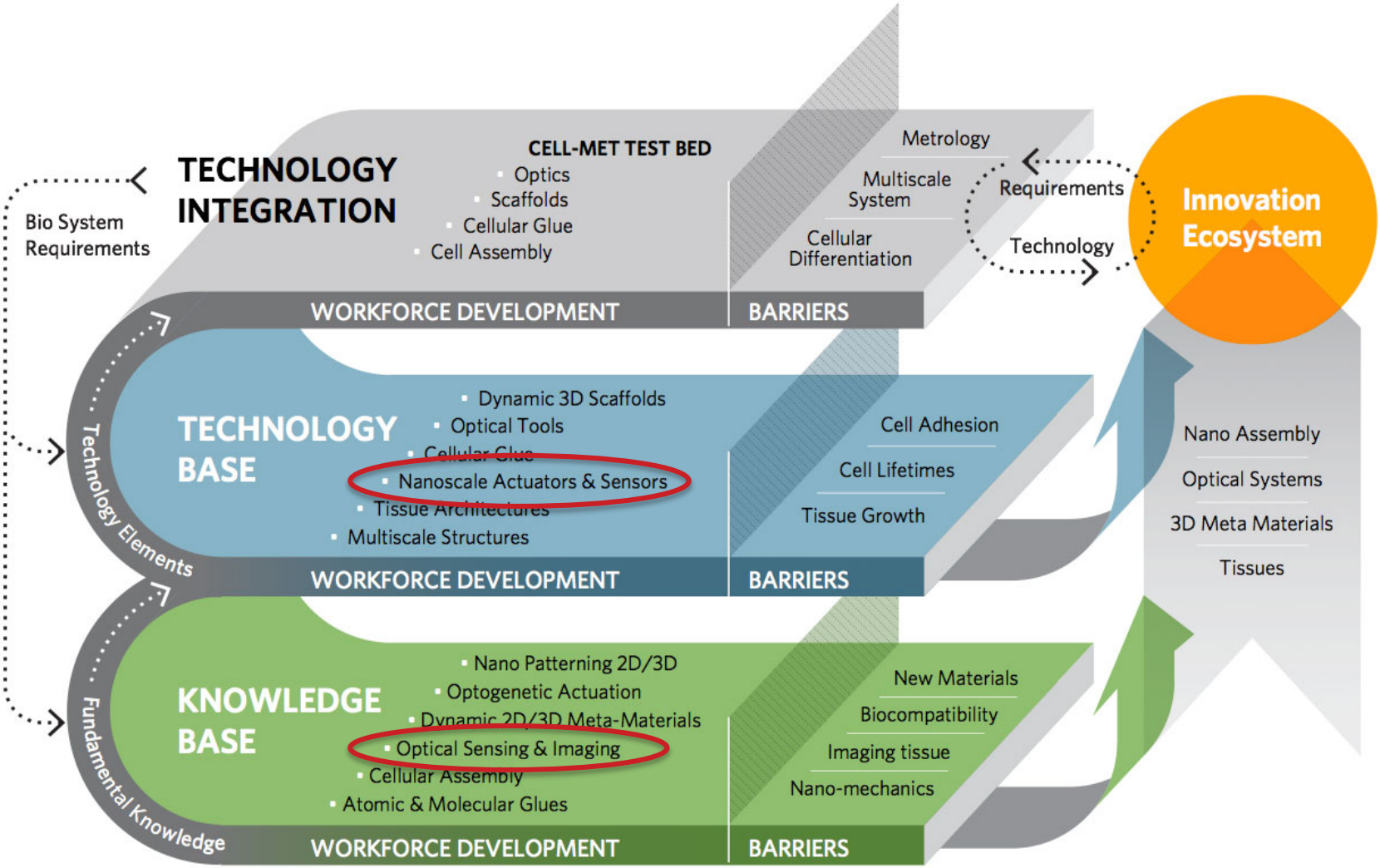

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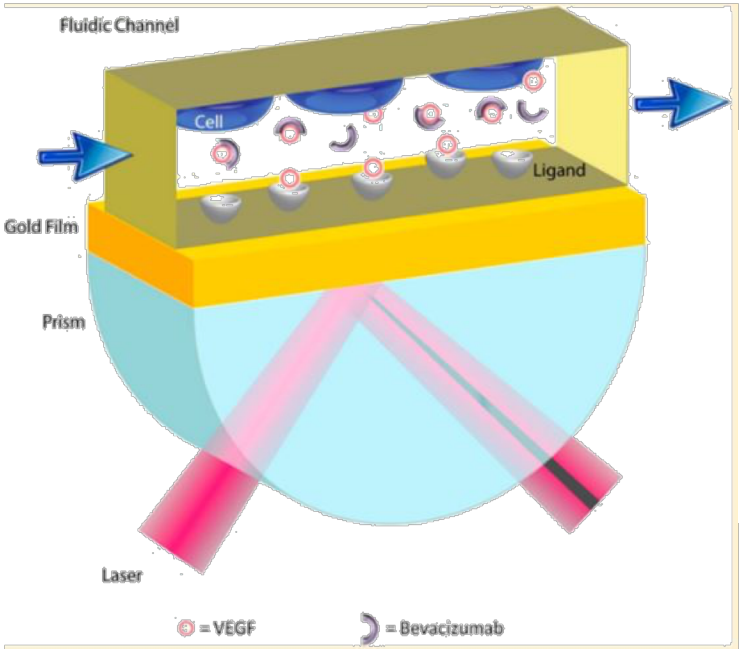
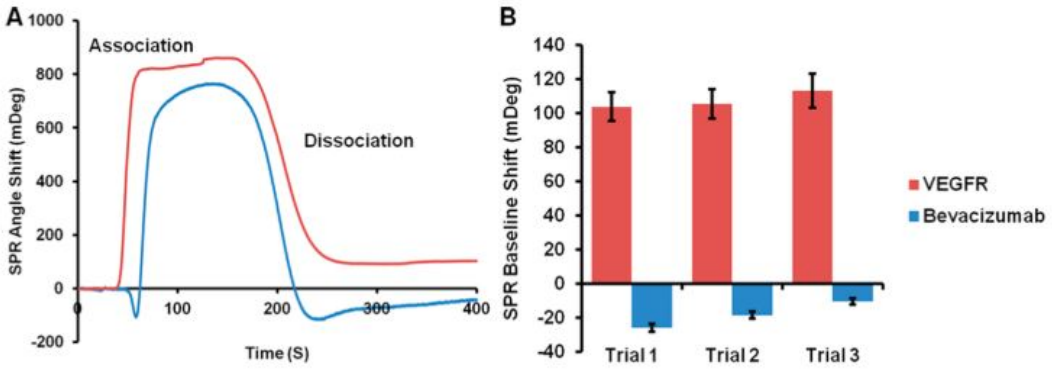
Cell-integrated SPR in our lab





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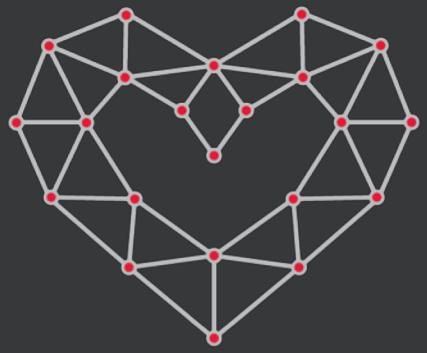
Cell-SPR Challenges

- Optical constructs might be complicated for a portable design
- SPR studies are not temperature or CO2 controlled. Such control chamber might be needed for prolonged studies.
- Sensors are reusable, but the thin layer of gold (45 nm) might be damaged after a few uses.
- 3D tissue maintenance and fabrication will be challenging, but not impossible!
- Incorporation of a brightfield could be very helpful.



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